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NOTES ON THE ORNITHOLOGY OF OXFORDSHIRE, 1896-1898.

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WHERE no other locality is mentioned, the notes refer to the parish of Bloxham.

1896.

January 1st.—The Rev. J. Goodwin, of Milcomb, told me that he had recently seen a Hawfinch in his garden.

25th.—Large numbers of Bramblings have frequented a stubble-field dotted with manure-heaps for a week or more; I saw a small flock to-day, but they were gone two days later. The Rev. J. Goodwin told me he saw some between here and Milton last week.

26th.—Blackbird singing; early. Nuthatch has the rapid rattling or trilling cry. Rooks at their nesting trees most of the day.

27th.—Chaffinch sang the first part of its song, and a portion of the second part.

February 3rd.—News from Mr. Fowler of a Peregrine Falcon shot at Sarsden last month while in pursuit of a Ring-Dove.

5th.—Only one Chaffinch singing; these birds are strangely scarce, although common a few days ago. Possibly the winter birds have just left. One of my nephews has stuffed a Kittiwake (immature), shot at Bodicote a fortnight ago.

6th.—News from Mr. W. W. Fowler that he saw a Hawfinch in Christ Church meadow on the 4th. He remarks, "Not a Chaffinch to be seen or heard."

15th.—Yellow Bunting singing.

17th.—Rooks very noisy at their trees.

26th.—News from Mr. W. C. Darbey that he had received a black Skylark from the neighbourhood of Stanton Harcourt.

March 6th.—Rooks began building.

7th.—A young Song-Thrush, fully fledged, brought to me.

10th.—A Grey Wagtail in the village brook. The body of a Peregrine Falcon (a Fox having bitten off the head), which had died of shot wounds, was picked up near Horton Spinney, Waterperry (H. G. T. *in litt.*).

16th.—Strong wind; one Rook's nest here blown out.

18th.—Rooks have built four more nests. There are now eight.

19th.—Saw two Chiffchaffs in the warm spot by the brook, where I always look for, and generally find, the first; one was in song.

24th.—Saw three Bramblings settle in a tree in the "Ridgeway." This is a late date for them to remain here.

25th.—The Rev. J. Goodwin told me of a pair of Hawfinches seen at South Newington, and a pair of Spotted Woodpeckers in an orchard at Hook Norton, recently.

26th.—News from Mr. Fowler that he heard six Chiffchaffs at Kingham on the 22nd; that the Rev. S. D. Lockwood saw the Wheatear there on the 20th; and that Mr. Foster-Melliar saw it the same day on Shipton downs. News from the last named that young Blackbirds flew on the 16th, and that he heard the Wryneck on the 22nd at North Aston.

April.—I had news this month from Mr. R. W. Calvert of a female Buzzard shot at Ascott-under-Wychwood, while flying away with a wounded Wood-Pigeon on the 30th December, 1881; and of another seen by him there in September, 1893 (*in litt.*).

2nd.—Went to Kingham to examine the Rookery destroyed by Crows (*vide Zool.* 1896, p. 144).

3rd.—A flock of about fifty Meadow Pipits in a grass field on Bloxham Grove.

7th.—Examined a Mealy Redpole (*Linota linaria*) which was



shot from a flock of about fifteen Redpoles at Wickham Mill in March.

10th.—A Swallow seen by Mr. D'Oyly Aplin over the Sorbrook at Bodicote.

13th.—A Swallow seen at Barford.

15th.—I saw a Wren's nest built in the fork of a young tree on the bank of the Swere. As an object the nest was very conspicuous; not so as a nest. It was built of flood-rubbish, and looked exactly like a bunch of this caught and left in the fork, as a bunch often is when a flood goes down. The hole in the nest faced the stream.

With regard to the date at which the Carrion Crow breeds, the following information, acquired while destroying the nests of this (with us too numerous) bird this spring, may be of interest:—April 15th, two birds shot from the nests, one of which sat until a stone was thrown at her; apparently both were incubating. April 17th, four birds sitting on nests. April 18th, bird sat on nest, about 25 ft. up in a young willow, until I came close under it. May 7th, bird sat on nest in tall elm until thrown at. May 8th, nest containing partly fledged noisy young. May 11th, nest with squab young, the pen-feathers just sprouting.

18th.—Willow Wren, Wheatear, and Ray's Wagtail appeared.

19th.—Several Tree Pipits singing; none the day before.

20th.—I think the resident race of Goldfinches must have been nearly exterminated by the frost of the early part of 1895. I could see none about here until a week ago; now I see a fair number. When in the garden to-day I heard loud alarm cries of Starlings, and, looking up, saw eight in a confused mass high in the air. They reformed, and went on in a N.E. direction, and what I believe was a Peregrine was flying away rather heavily; but I could not tell for certain whether it was carrying anything or not. I believe that a good many of the Starlings we see here in April, and even in May, are not going to breed, here at least. Even as late as mid May one sees little parties, up to a dozen or a score in number, flying overhead rather high up. They may be birds which are going to breed in the far north.

21st.—Redstarts appeared. My wife saw half a dozen "Black-birds, one light coloured underneath," fly out of an ivied tree at the edge of Milcomb gorse. This is about the date at which the

Ring-Ouzel has visited us, and it has occurred in this gorse before. I have no doubt these birds were Ring-Ouzels.

22nd.—Swallows appeared about the village. There is always an interval between the appearance of a few early birds and the arrival of the birds about this date in numbers.

23rd.—A Turtle-Dove seen at Woodperry by Mr. H. G. Thomson.

24th.—Cuckoo appeared.

We spent a week at a village in the Chiltern hills about this date, and were delighted to find that the Stone Curlew still inhabited the downs. We located three pairs, and examined a specimen shot at Assendon in September, 1894, and another in an old collection of birds at an inn. A portion of the 'Weekly Dispatch,' 1860, was pasted on the back of the latter case. Grasshopper Warblers were frequently heard on the gorse-covered commons, and Nightingales were not uncommon; at Henley they seemed to be more numerous, and we heard three singing at once there, and not more than fifteen yards apart. Although there is much beech-wood on the hills, we could find no Wood Wrens; in my experience this bird chiefly frequents oak-wood. We saw one day a large hawk which I believe was a Honey Buzzard (darker than a Buzzard, with more pointed wings and a longer tail) flapping slowly overhead. It passed over D'Oyly Wood towards the big woods at Stonor.

The Red-legged Partridge was seen at Stonor and Henley. A great many Peewits still breed on the slopes of the downs and the open stony fields at the foot. We saw hundreds of pairs. On April 30th we watched four young ones in down, perhaps a week old, near some penned sheep. There is a raised ridge of down to be seen at the back of the occiput, making them crested even at that early age. A Sparrowhawk took a bird from the hedge close to us, and, popping over our heads, flew, heavily cumbered, against the wind, low over a big ploughing. Time after time a Peewit rose under him, and he was mobbed all along his course, one bird handing him on to another, until he reached the shelter of the spruce and larch belt, which doubtless held his nest. Some Wheatears apparently breed on the downs; we saw two pairs. Stonechats, which I remembered very common about the juniper bushes on the hills sixteen years earlier, were very

scarce. I think these birds must suffer greatly from hard winters. I examined, at Henley, a Little Owl shot at Turville Heath at the end of 1894. The birdstuffer told us he preserved three local Little Auks during the visitation in January, 1895. I may mention that one obtained on Port Meadow at that date is preserved in the University Museum; the Chipping Norton example has come into my possession. In an old collection of birds at an inn I found a specimen of White's Thrush; unfortunately no particulars respecting the collection are forthcoming. During our stay we noticed the arrival or presence of Grasshopper Warbler, April 25th; House Martin, 26th; Whitethroat, 26th; Lesser Whitethroat, 27th; Common Sandpiper, 29th; Sedge Warbler, 29th; Swift, May 1st; Turtle Dove, 1st. We heard the Wryneck twice; this bird is not common now in Oxon.

In Oxfordshire the Stone Curlew is known as the Curlew or Curloo. Barren open stretches on the undulating downs, as open and exposed as possible, are the haunts the Curloos chose; for there the bird's long legs and watchful eye enable him to guard against a surprise. The spot they select on our hills may be a vast field, partly under plough and partly derelict arable land, fallen back to poor condition, or "tumbled down," as they say, sweeping smoothly down to the foot of the hills in gentle basin-like slopes. Here on the short bare grey-green herbage, strewn with grey-and-white flints, the great down Hares sit out in perfect safety. As I examined the field with the glasses I counted five of them. Many pairs of Peewits were scattered over the field, and now and then one or two would get up and tumble about in the air, and their sweet calls came softly up. Rooks and Starlings were dotted about, the former probably up to no good. Again, the haunt may be a turfy down, with a great white blaze on its side, and on its lower slopes big juniper bushes, some old yew trees, and a belt of spruce and larch. The scrubby herbage is strewn with flints and white chalk-stones raked out of the rabbit-burrows, where a pair of Wheatears flit and run. From its most barren slope, thickly strewn with flints and chalk-stones, and sparsely clothed with short wiry grass and stonecrop, and dotted with dead plant-stems a foot high, I heard the "clamour" of the Curloo; and from it a pair rose and settled again, in view, but where the dead stems stood thickly. On being raised once

more they went over a swell in the down, where, with the glass, I could just see against the sky the head of one bird peeping at me over the ridge. When I followed, one sounded the alarm before I could see more of them, and they flew back to the old spot. A great undulating arable field, on a slope, its surface one mass of flints, held another pair. The cry of the Stone Curlew sounds to me *cur-lwee* or *curl-wee*, sometimes *currr-lwee*. A shrill sound, the second syllable drawn out and very sweet. Sometimes the cry is repeated several times quickly; this seems to be the "clamour." From the slight opportunity I have had of making observations, it seemed to me that the "clamour" was uttered when the bird was on the ground. Once, after a pair settled, one further on than the other, the former called, and the other bird ran up. When taking one of their quick runs (they go very fast) with sudden stops, they exchange an upright position for a stooping one, with the body nearly horizontal. I have seen Bustards run in just the same way. One bird was mobbed after settling, and after taking short runs, by Peewits, which stooped down and buffeted him; but he only ducked his head each time. I once (but not in England) came suddenly on a pair of Stone Curlews not ten yards from me. One struck a curious attitude, facing me (while the other ran up to it), and staring fixedly at me with its large beautiful yellow-irised eye.

May 2nd.—Reed Warbler at Oxford.

9th.—A Nightingale at Milcomb gorse. Swifts numerous here; not seen earlier.

12th.—Among the Rooks shot here were two with part of the lower mandible light-coloured, in one white, the other buffy white; another with a black bill had the whole of the chin-feathers white. Turtle Dove appeared.

14th.—Spotted Flycatcher appeared. These birds arrived at Bodicote on the 13th. The old nest over the drawing-room window there has been taken down, as it was in a very foul condition. The birds used it for four years, and reared two broods each year.

16th.—Spotted Flycatcher singing. The song was continuous, but low in tone; there was no attempt at a fixed strain, and the notes were just jerked out (but there were sweet notes here and there), and the song was distinctly Shrike-like in character.

20th.—News from Mr. Fowler that Mr. Pycraft saw a Cormorant at King's Weir, Oxford, on the 17th, and a Black Tern.

22nd. — Mr. Fowler saw a Blue-headed Wagtail on Port Meadow; "white eye-stripe, and a very dark head even for that species, I should say" (*in litt.*).

24th.—A Song Thrush sang from the ridge of the house-roof. It uttered its rattling alarm-note once in the song, and the quiet alarm-note two or three times. But this might have been accounted for by the fact that it was uneasy.

28th.—A Spotted Flycatcher in the garden is an unusually frequent singer. The song is low, but shrill; weak, yet remarkable when heard at a short distance. It comes tinkling out like the sound of a tiny streamlet, but the notes are thin and shrill.

The Rev. J. Goodwin tells me of a Hawk, which, I think, must be a pale grey Harrier, seen at Broughton lately.

29th to July 8th.—Away in Norway.

June 5th.—The Marsh Warbler arrived at its favourite osier-bed at Kingham for the fifth year, and was heard by Mr. Fowler to-day, the same day as in 1892. It was only heard in song occasionally after the 13th. Nest found on the 27th.

July 10th.—Brancher Spotted Flycatchers.

19th.—Covey of Partridges, thirteen in all, the young nearly as large as the old. Hot dry weather for some weeks.

20th.—Another covey with young quite as big.

August 4th.—Saw a Hobby at Rignell Spinney, near Barford St. Michael.

10th.—Many Swifts; very noisy.

11th.—Not many Swifts to be seen, though some still nesting. Saw a Nightingale in the paddock-walk. How little we know of this bird in the late summer. Also saw a Wren's nest, which I had never noticed before. It was against the trunk of a slightly ivied tree, and built of moss with a thick outside covering of some plant. The latter is now withered and brown, and the nest is very conspicuous (a great drought had prevailed during summer), but I have no doubt the plant was green when the nest was built.

13th.—Still some Swifts.

14th.—About this date I saw a flock of fourteen Missel Thrushes.

26th.—One of my nephews at Bodicote reported that early in the night of the 24th Wild Geese (cackling like tame Geese) passed over low enough down for the swish of their wings to be heard. I believe these early grey Geese are Grey-Lags. The late Lord Lilford wrote:—"I can speak positively as to the occasional passage of flocks of Grey-Lags over the neighbourhood of Lilford in September and October from my intimate knowledge of their cries, which exactly resemble those of our farm-yard and stubble Geese, who are no doubt lineally descended from this species. These cries differ greatly from those of the three other species of 'grey' Geese that occasionally visit us late in the season. . . . Many reports of their passage near home annually reach me, and although I am well aware that the present species is considered to be rare in our part of England, I am nevertheless inclined to think that such reports in August, September, and the first half of October are generally referable to the Grey-Lag." ('Birds of Northamptonshire,' vol. ii. p. 140.)

September 16th.—Many Meadow Pipits in standing mustard.

18th.—Many Pied Wagtails on the fresh ploughings.

28th.—Many Meadow Pipits in slightly flooded meadow. Saw two Turtle Doves; a rather late date.

30th.—Big flock of migratory Peewits.

October 1st.—Close and warm. A Missel Thrush singing fairly well. A rare occurrence in autumn. Blackbirds, abundant for some weeks, are now extraordinarily numerous.

10th.—A Grey Wagtail in the brook below the village.

17th.—Meadow Pipits roosting on a high-lying barley-stubble, with a great deal of sprouted shed corn; they were not there early in the afternoon.

19th.—Grey Wagtail in the brook.

20th.—A few Fieldfares. An immature Golden Plover shot at Ascott-under-Wychwood by Mr. Calvert (*in litt.*).

21st.—Mr. Darbey, of Oxford, informed me he had received a good many locally-killed Gulls recently, and showed me examples of the Herring Gull, Common Gull, and Kittiwake.

29th.—Vast flock of Starlings on barley-stubble; a little flock of Meadow Pipits in roots late in the afternoon. A good many Redwings. It was reported in the 'Banbury Guardian' that

Mr. Valance Elam, of Little Tew Lodge, Enstone, flushed eight Woodcocks in one cover on the 24th.

November 2nd. — Near Heythrop, where these birds are numerous about the stone-wall country, as the sun came out to-day, the Common Bunting was singing gaily.

6th.—A Sand Martin was seen at Milcomb by two friends of mine who know the bird well.

16th.—This afternoon, at 3.40 p.m., I noticed a great noise and excitement proceeding from eight or ten Hedge-Sparrows which were scattered about in a laburnum and some orchard trees. They became silent when I went out to look at them, but soon began again, answering one another with their thin *tseek*. No cat or other vermin was to be found, and the birds were in some cases some distance apart. The excitement lasted about a quarter of an hour. It was near roosting-time. I have once or twice since noticed a similar occurrence.

22nd.—A very mild but dull day. A Blackbird sang for some time just before sunset. The notes were rather poor, but numerous. Perhaps the bird was a young one of the year, early hatched, as many were last spring. In my experience the Blackbird is very rarely heard to sing in autumn.

30th.—A Water Rail shot close to the village. In two swede-fields I found a good many Meadow Pipits: a late date for a flock to be here.

December 6th.—Missel Thrush singing well.

9th.—Wind strong from the south. A flock of about two hundred Ring Doves passed over at a fair height, going due south, and battling with the wind.

11th.—Song Thrushes sing very well now.

18th.—Severe frost for the last few days. Two Jack Snipe shot.

19th.—Vast flock of Chaffinches on clover and stubble; as far as I could see they were all females.

24th.—Another Jack-Snipe shot here.

31st.—A Slavonian Grebe shot at Chimney-on-Thames. It is now in the Oxford Museum. In the course of correspondence about this bird with Mr. Darbey, he gave me information of the following Oxfordshire examples of this bird, not previously recorded:—One picked up at Pink Hill (or Pinkle) Lock, near

Eynsham, in the winter of 1893 ; in the possession of Mr. Curtis. One killed in the same winter on Port Meadow ; in the possession of Mr. Greenwood, of St. Giles Street. Another in the same winter on Port Meadow ; preserved for an undergraduate of Keble College. One killed in the winter of 1895-96 on the Isis, at Oxford. One killed at Newbridge in January, 1896 ; in the possession of Mr. George Kent, of Newbridge.

Mr. A. H. Cocks reported in 'The Zoologist' that eight adult Sandwich Terns passed the greater part of the 10th April, 1895, at Great Marlow, going in the afternoon about three-quarters of a mile up the river (*vide* 1895, p. 190). These birds were not far from our borders.

(To be continued.)

BIOLOGICAL SUGGESTIONS.

MIMICRY.

BY W. L. DISTANT.

(Continued from p. 363.)

IN the following discussion on "Demonstrated," "Suggested or Probable," and other categories of views and suggestions relating to this more than interesting question, recourse has been somewhat plentifully made to original quotations, giving full references to the authors and publication of the same. This course may be probably commended for several reasons. In the present day much biology is written on the historical method,* in which conclusions and facts are worked together in one harmonious whole, and treated as canonical information, to which reference to the original sources of information is unnecessary. But in Biology, surely we should bear in mind—(1) Justice to the original author—A. Reference to the work in which the quotation appears, and which may be unknown or neglected by the reader, who may thus—(a) find other facts besides those quoted; (b) find that such quotations should be qualified by other information in the same work; (c) be led to consult the same authorities with reference to other investigations he may have in hand. Besides which, the evidence for or against this theory must be cumulative, and we must not be misled by successful advocacy either one way or the other.

* This method is not to be despised, as Lord Acton has well observed : —"Method is only the reduplication of common sense, and is best acquired by observing its use by the ablest men in every variety of intellectual employment. Bentham acknowledged that he learnt less from his own profession than from writers like Linnæus and Cullen; and Brougham advised the student of Law to begin with Dante. Liebig described his 'Organic Chemistry' as an application of ideas found in Mill's 'Logic,' &c. ('A Lecture on the Study of History,' p. 53.)

Illustrations of Demonstrated Mimicry.

Butterflies of other families are found as mimics of the *Danaidæ* and *Heliconiidæ*, which have been shown to be generally uneatable, and avoided by Birds, Dragonflies, Lizards, and other enemies. The fact that the writer found a *Danais chrysippus* being devoured by an orthopterous insect (*Hemisaga prædatoria*)* is only another illustration of the much used motto—the exception proves the rule. The glands near the anus of some *Heliconiidæ* have also been proved to emit a pungent odour. These facts have been recorded by Bates, Belt, Trimen, Wallace, and others. But Mr. Frank Finn, who has made some careful experiments to test the “Theory of Warning Colours and Mimicry,” certainly found that his birds in captivity not only ate, but sometimes seemed to prefer, specimens of *Danais* and *Euplœa*. Nevertheless, when he experimented with birds at liberty, he had not the slightest doubt “as to the unpalatability of *Danais*, and the other ‘warningly-coloured’ forms. Birds would often look at them, and soon left them when picked up.” But when he further experimented with the common garden Lizard of India (*Calotes versicolor*), he came to the conclusion that “the behaviour of these reptiles certainly does not appear to afford support to the belief that the *butterflies* at any rate, usually considered nauseous, are distasteful to them.”†

Miss Newbigin is also a sceptic on this point, based on her physiological study of animal colouration. She remarks:—“Instead therefore of supposing that the *Heliconiidæ* have, in Mr. Wallace’s words, ‘acquired lazy habits’ and a slow flight because they are uneatable, and the *Pieridæ* because they resemble the *Heliconiidæ*, may we not rather suppose that the slow flight and ‘warning’ colours in both cases are due to the same cause, the relatively low organisation which renders pigmentation by waste products possible, which makes brilliant optical colours impossible?”‡ As appertaining to this subject, Mr. Hopkins has demonstrated the presence of uric acid in the wing-pigments of the *Pieridæ*, and observes:—“The described uric acid derivatives, though

* ‘A Naturalist in the Transvaal,’ p. 65.

† Cf. J. A. S. Bengal (Nat. Hist.), vol. lxiv. pp. 344–56; and vol. lxv. pp. 42–8.

‡ ‘Colour in Nature,’ pp. 161–2.

universal in the *Pieridæ*, are apparently confined to this group among the Rhopalocera. This fact enables the interesting observation to be made, that where a Pierid mimics an insect belonging to another family, the pigments in the two cases are chemically quite distinct. This is well seen in the genera *Leptalis* and *Mechanitis* respectively.* The experiments and conclusions of Dr. McNunn and Miss Newbigin in relation to the green pigments in Invertebrates have already been referred to in these pages (*ante*, p. 430).

The leaf-like Phasmid (*cf. ante*, p. 303) observed by Mr. Belt standing immovable among a host of foraging ants, many of which ran over its legs without discovery that food was within their reach.† (This may also be taken as an illustration of "Active Mimicry," referred to subsequently.)

The larvæ of Geometrid Moths, which so resemble the twigs on which they rest as to deceive their enemies. Rösels gardener, mistaking one of these caterpillars for a dead twig, started back in great alarm when, upon attempting to break it off, he found it was a living animal.‡ Burmeister was similarly deceived by the larva of *Ph. quercinaria*, Borkh. (*Eunomus erosaria*, Tr.), "mistaking it for a small dry twig upon wishing to break off a small twig of oak."§ Mr. Jenner Weir writes:—"After being thirty years an entomologist, I was deceived myself, and took out my pruning-scissors to cut from a plum-tree a spur which I thought I had overlooked. This turned out to be the larva of a Geometer two inches long. I showed it to several members of my family, and defined a space of four inches in which it was to be seen, but none of them could perceive that it was a caterpillar."||

In plants, *Matricaria chamomilla* is considered a mimic of the true Chamomile, which from its bitterness is not eaten by quadru-

* 'Proc. Roy. Soc.' lvii. pp. 5 and 6 (1894).

† 'The Naturalist in Nicaragua,' p. 19.—Prof. S. D. Judd, who has made a special study of the subject, records an observation to be remembered:—"I am surprised to find that Grasshoppers (*Acrididæ* and *Locustidæ*), in spite of their protective coloration, are eaten by over three hundred species of birds in the United States." ('Amer. Nat.' vol. xxxiii. p. 468.)

‡ Rös. i. v. 27. Quoted by Kirby and Spence. 'Introd. Entomol.' 7th edit. p. 413.

§ 'Manual of Entomology,' Shuckard's transl. p. 505.

|| 'Nature,' vol. iii. p. 166.

ped. *Ajuga chamæpitys* is a mimic of *Euphorbia cyparissias*, with which it often grows, and which is protected by its acrid juice. The most familiar case, however, is that of the Stinging and the Dead Nettles. They very generally grow together, and, though belonging to quite different families, are so similar that they are constantly mistaken for one another.* But even here caution is necessary in many cases before giving a verdict for mimicry as generally understood. Zopf (1892), in studying the colouring-matter of the fungus *Pilobolus*, found that a parasite growing on the fungus took up not only the drops of oil, but also the pigment associated with the oil, the result being that parasite and host were similarly coloured.† Poulton has also shown that the green pigment of some caterpillars is derived from the green leaves upon which they live.

It is to be remembered, however, as Mr. Ridley has remarked, that it is not essential that fruits should be flavoured to our taste in order to induce birds or animals to swallow them. In the Malay Peninsula "the *Macaranga* capsules, covered with a viscid gum most unpleasant to the mouth, the hot Capsicums, the drupes of the palms (*Kentia macarthurii*), the berries of the wild grapes (*Cissus* spp.), which have a most irritating effect on the mouth, and the poisonous fruits of *Sapium*, are all highly popular with birds, and even the fruit of *Strychnos tieute*, Bl., with its intensely bitter pulp, is eaten by Civet Cats. A large number of the wild fruits, too, though very astringent, are sometimes eaten by birds or animals."‡ In the North-West Provinces of India, Mr. Silberrard has known Goats to "frequently eat, without any ill-effect, the leaves and green stems of the 'Akaúa' or 'Madar' (*Asclepias* or *Calotropis gigantea*), the milky juice of which is an acrid poison for human beings, and is frequently used as such in infanticide cases."§

Illustrations of Suggested or Probable Mimicry.

We do not suggest, or in any sense imply, that the few and scanty instances we have given of "Demonstrated Mimicry" are at all commensurate with the much larger number that could be

* Sir John Lubbock, 'The Beauties of Nature,' p. 156.

† Cf. Miss Newbigin, 'Colour in Nature,' p. 41.

‡ 'Natural Science,' vol. viii. p. 190.

§ 'Nature,' vol. lix. p. 177.

adduced. But an illustration was alone intended. In the present category the records are, however, much more numerous, and considerably more familiar, to all who take an interest in the subject. We are now in the realm of suggestion, and among naturalists who incline to theory there is often much faith. As Lecky has observed, referring to another subject, "Their measure of probability ultimately determines the details of their creed." *

Recently a new suggestion has been made as to "Nocturnal Protective Colouration in Mammalia, Birds, Fishes, Insects, &c., as developed by Natural Selection." The author, Mr. A. E. Verrill, truly remarks that much has been written in respect to the imitative and protective colours of these groups, as seen by daylight, and the bearing of these facts on natural selection is well known. Very little attention has been paid to their colours, as seen by twilight, moonlight, and starlight. Yet it is evident that protection is more needed during the night than in the daytime by a very large number of species. This is the case with those that move about in search of their food at night, as is the habit of numerous forms of small mammals, such as rodents (Rats, Mice, Arvicolæ, &c.), insectivores (Moles, Shrews, &c.), many herbivores, various marsupials, and members of other orders. Many carnivorous species, which seek their prey at night, will also find advantages in such protective colours, for thus they will more easily escape the notice of their prey. Hence many nocturnal carnivores are black or nearly so, as the Mink, Fishes, some Bears, &c. The same principles will apply to birds, reptiles, fishes, and to insects, both in their larval and adult states, for many members of all these groups are very active at night, and hide away in holes or beneath dense herbage by day. . . . Many nocturnal insects that live on the ground are black or dark brown, which are colours that are protective only

* Charles Kingsley complained:—"Weak and wayward, staggering and slow, are the steps of our fallen race (rapid and triumphant enough in that broad road of theories which leads to intellectual destruction)." ('Glaucus,' p. 30.) Perhaps Kingsley would have approved of an old and summary method, as described by Gibbon:—"A Locrian who proposed any new law stood forth in the assembly of the people with a cord round his neck, and, if the law was rejected, the innovator was instantly strangled." ('Decline and Fall.') Dr. A. B. Meyer has recently remarked:—"It must be admitted that it is not very difficult to invent pleasing and clever hypotheses, specially convincing to the laity." ('Distribution of the Negritos,' pp. 81-2.)

at night. This is true of most ground-beetles, many Crickets, Cockroaches, Ants, &c. Many of these insects hide away in the daytime, so that no protective colours are then needed. But many insects that are exposed both during the day and at night have acquired green or yellowish colours that are protective at all times, when living among foliage. Green-grasshoppers, Katydid, &c., are examples."*

Sometimes we find varied or almost contradictory suggestions, as has been applied to the resemblance of Tree-Shrews to Squirrels. Lydekker considers this may have been originally due to the extreme agility of the latter animals insuring them from pursuit by other creatures, as being a useless task. Hence it would clearly be an advantage for a slower animal to be mistaken for a Squirrel.† Wallace suggests that the resemblance is probably due to the Squirrels being harmless creatures which cannot alarm the insects around them by their movements, so that the Insectivora which resemble them easily capture their food.‡ Another protective quality possessed by Squirrels has been conjectured by Poulton as existing in its large bushy tail: "An enemy in pursuit would be liable to get only a mouthful of fur."§ Ridley, in commenting on this proposed mimicry, is much more cautious: "If this resemblance is to be reckoned an example of mimicry, it is not easy to decide whether it is the *Tupaia* which mimics the Squirrel, or the Squirrel the *Tupaia*. Possibly the resemblance is accidental, both animals having taken on the most inconspicuous colouring, and the most suitable form for their environment."|| Mr. Oldfield Thomas considers that the resemblance between the *Bassaricyon*, a Raccoon-like type of animal (known at present only by a single skull from Costa Rica and a skin from Ecuador)¶ to the Kinkajou (*Cercoleptes caudivolvulus*), a well-known Raccoon inhabiting Central America and Northern Brazil, is a case of true mimicry, although he is unable to

* Abstract of a paper read before Morphol. Soc. 'Amer. Journ. Sci.' Feb. 1897 ('Ann. and Mag. Nat. Hist. Sixth Series, vol. xix. 354-6).

† 'Royal Nat. Hist.' vol. i. p. 314.

‡ 'Nat. Select. and Trop. Nature,' p. 76.

§ 'Colours of Animals,' p. 209.

|| 'Natural Science,' vol. vi. p. 28.

¶ Mr. Thomas informs me that the Brit. Mus. has very recently received a second specimen.

imagine of what advantage it can be for the Bassaricyon to be mistaken for a Kinkajou.* The Cape Hunting-Dog (*Lycaon pictus*) has a superficial resemblance to the Spotted Hyæna of the same country, which has been suggested as a case of mimicry. As Mr. Lydekker has observed :—"It is, however, very difficult to see what advantage a strong animal hunting in packs, like the present species, can gain in being mistaken for a Hyæna, as it is in every respect fully qualified to take care of itself. If, however, we could suppose that the Hunting-Dog was originally a solitary animal, which had subsequently become gregarious, then perhaps the resemblance to the Hyæna might have been an advantage to it."† The same authority believes that in the resemblance of the South African Weasel (*Pœcilogale albinucha*) to the Cape Polecat (*Ictonyx zorilla*) we may have "another instance of true mimicry among mammals."‡ The African Monkey (*Colobus occidentalis*) is covered with a long silky fur arranged in alternate stripes of black and white, so handsome that the skin is much prized by the Masai for making head ornaments. The contrast of black and white is so marked that at first sight, as Dr. Gregory remarks, "it would seem to preclude concealment, but its value is at once evident when the animal is seen at home. This Monkey lives in the high forests of Abyssinia, Kenya, Kilima Njaro, and Settima, where the trees have black trunks and branches, draped with long grey masses of beard-moss or lichen. As the Monkeys hang from the branches they so closely resemble the lichen that I found it impossible to recognize them when but a short distance away."§

The tabby Cat, the original progenitor of which may have been "a distinct natural variety which no longer exists as a wild animal," has been thus described :—When "curled up asleep, the dark bands arranged themselves in concentric circles, or rather in a closely set spiral, strongly suggesting the appearance of a coiled serpent." This is considered as a probable remarkable instance of "protective mimicry."||

Mr. S. E. Peal, writing from Assam, has launched the following

* 'Proc. Zool. Soc.' 1880, pp. 397-99.

† 'Royal Nat. Hist.' vol. i. p. 571.

‡ *Ibid.* vol. ii. p. 70.

§ 'The Great Rift Valley,' p. 272.

|| Louis Robinson, 'Wild Traits in Tame Animals,' pp. 240-1.

suggestion: Certain tan-spots occur over the eyes of semi-domesticated Dogs. They do not exist in wild animals allied to the Dog, or in the modern breeds of fully-domesticated Dogs. The spots are most conspicuous when the eyes are closed, appearing then like opened eyes. They "may have been protective to the animals during sleep, causing them to look as if wide awake." This speculation has been supported by no less an authority than Mr. A. R. Wallace.* Waterton, in describing the South American Sloth, writes: "His fur has so much the hue of the moss which grows on the branches of the trees that it is very difficult to make him out when he is at rest."† The Philippine Koel, or Phow (*Eudynamis mindanensis*), one of the Cuckoos, is an example of a bird in which the young does not follow the general rule of having the plumage of the female, or one distinct from that of both parents. Mr. Whitehead accounts for this by the fact of the Phow laying its eggs in the nest of the Yellow-wattled Myna. "The young Cuckoo, being black, does not differ from the young Myna, and so the deception is carried on until the young bird can take care of itself. If the young followed the general rule, and resembled their mother in being of a brown colour, the Mynas might not feed them."‡ Of the Matamata Tortoise (*Chelys fimbriata*), a South American species, it has been observed:—"When in its native element the warty appendages on the neck float in the water like some vegetable growth, while the rugged and bossed shell strongly resembles a stone; it is thus probable that the whole appearance of the creature is advantageous either in deluding its enemies or in attracting to it the animals on which it feeds, the latter being the most likely hypothesis. Although it appears that the Matamata will occasionally eat vegetable substances, its chief food consists

* 'Nature,' vol. li. p. 533.

† 'Wanderings,' Wood's edit. p. 219.—We may here refer to "the law which underlies Protective Coloration" as propounded by Mr. Abbott H. Thayer, the law of gradation in the colouring of animals, which "is responsible for most of the phenomena of protective coloration except those properly called mimicry. . . . Mimicry makes an animal appear to be some other thing, whereas this newly-discovered law makes him cease to appear at all." Thus "animals are painted by nature darkest on those parts which tend to be most lighted by the sky's light, and *vice versa*." (Cf. 'The Auk,' vol. xiii. 1896; and reprint 'Ann. Rept. Smith. Instit.' for 1897, p. 477).

‡ Cf. 'Royal Nat. Hist.' vol. iv. p. 7.

of fish, frogs, and tadpoles, some of which may probably be attracted within reach by mistaking the appendages on the neck for plants or animals on which they feed.”* “There occurs at the Cape of Good Hope a harmless egg-eating Snake (*Dasypeltis scabra*), which flattens its head, coils as if for a spring, hisses, and darts forward as though about to strike in a way that closely resembles the characteristic mode of the Berg-Adder (*Vipera atropos*), of which it is mimetic. It is really quite harmless, subsisting on eggs, the shells of which are broken in the throat by the enamel-tipped processes of the vertebræ, which project into the gullet, and form the so-called gular teeth; but its resemblance both in form and behaviour to a venomous Snake presumably affords it protection from enemies.”†

When we approach the annals of entomology,‡ we find this explanatory idea permeating the whole subject. To suggest a new instance of mimicry is considered more desirable by many than to describe a new species; while the advocates or followers of both procedures do not always seem to practise mutual admiration. The observations are not all modern. The old Swedish traveller in South Africa, Dr. Sparrmann, who first discovered (1775) the curious hemipteron, *Phyllomorpha paradoxa*, was impressed by its mimetic resemblance to a leaf. “At noon-tide I sought for shelter among the branches of a shrub from the intolerable heat of the sun. Though the air was now extremely still and calm, so as hardly to have shaken an aspen leaf, yet I thought I saw a little withered, pale, crumpled leaf, eaten as it were by caterpillars, flittering from the tree. This appeared to me so very extraordinary that I thought it worth my while suddenly to quit my verdant bower in order to contemplate it; and I could scarcely believe my eyes when I saw a live insect, in shape and colour resembling the fragment of a withered leaf, with the edges turned up and eaten away, as it were by caterpillars, and at the same time all beset with prickles. Nature, by this peculiar form, has certainly extremely well defended and concealed, as it were in a mask, this insect from birds and its other

* ‘Royal Nat. Hist.’ vol. v. p. 91.

† C. Lloyd Morgan, ‘Habit and Instinct,’ p. 12.

‡ Poulton has focussed many observations respecting instances in the Insecta, largely augmented by information received from the well-known coleopterist, C. J. Gahan. (Cf. ‘Journ. Linn. Soc.’ xxvi. pp. 558–612 (1898)).

diminutive foes.”* Canon Fowler, who has been recently writing on the *Membracidae* (Homoptera), referring to the genus *Sphongophorus*, opines that, in some cases at all events, these forms are protective, for, when at rest, many of the insects must† resemble pieces of dry twigs.”‡ One of the most interesting, but, to the writer, inexplicable, instances is given and figured by Dr. Gregory, as observed in Eastern Central Africa. In this case numbers of a species,—or of more than one,—of the homopterous sub-family *Flatinae* (*Ityraea nigrocincta*) adhere to a stem, and closely resemble a flowering Transvaal plant (*Sesamopteris pentaphylla*). The observer adds:—“It may be that the insects were only rendered sluggish by the cold and rain, but it appears not unlikely that the members of this species have very limited powers of flight, and secured protection from birds by this ingenious mimicry of a cluster of flowers.”§ I have frequently seen other insects after heavy rain in the Transvaal follow the same habit without any protective resemblance being obtained.|| A common orthopteron in La Plata (*Rhomalea speciosa*), when at rest, is “only a pretty Grasshopper; but the instant it takes wing it becomes the fac-simile of a very common Wasp of the genus *Pepris*.”¶

Prof. C. Emery has published, in the ‘Bull. del Soc. Ent. Ital.’ 1886, a short but interesting note on the habits of an Ant (*Camponotus lateralis*). Of this species there are two varieties—one black, like its nearest allies, the other red, with the abdomen and part of the thorax black. They live in small colonies, and make expeditions up trees to collect honeydew from the aphides. The black type (*C. foveolatus*, Mayr; *C. ebeninus*, Emery) sometimes go in troops, but generally a few join the troops of other

* ‘Voyage to Cape of Good Hope,’ Engl. transl. 2nd edit. vol. ii. p. 16.

† “Must” is an unfortunate expression, and in most arguments is equivalent to “it is evident,” which the late Prof. Clifford described as meaning “I do not know how to prove.” (‘Lectures and Essays,’ 2nd edit. p. 176.)

‡ ‘Biologia Centrali-Americana,’ Rhynch. Homopt. vol. ii. p. 26.—Whatever we may think of this suggestion, it is at least not more improbable than some banter which lately appeared in an American entomological work by Dr. Comstock, where we read that as regards the *Membracidae*, “Nature must have been in a joking mood when Tree-hoppers were developed.”

§ ‘The Great Rift Valley,’ pp. 273–5, and figured on coloured frontispiece.

|| Cf. ‘Zoologist,’ 1898, p. 256.

¶ W. H. Hudson, ‘The Naturalist in La Plata,’ p. 127.

black Ants, such as *Formica gagates* and *Componotus æthiops*. Prof. Emery suggests that, their numbers being small and their sight not very good, they find it convenient to accompany other Ants which live in larger communities, and they perhaps escape detection from the similarity of colour.”*

Mr. Skuse considers that the Australian Hepialid moth (*Leto stacyi*, Scott) resembles *in situ* an approach to the head of a reptile of the genus *Varanus*. “The moth is one which passes its larval state in the butts of Eucalyptus trees for the period of five or six years, but on emergence the perfect insect is not prone to fly, and would therefore be very liable to be attacked by birds. Hence the probability that my surmise of the striking resemblance to the head of a Lizard being an instance of genuine protective imitation is correct.”† Of the larvæ of the Hawk-Moth (*Chærocampa porcellus*), it has been stated that should it “be discovered among the dead leaves, where it usually lies concealed, the first four segments are suddenly retracted, and, as in the case of *C. celerio*, the animal appears to have a very large head, with two glaring and dangerous-looking eyes. This transformation is no doubt of use for defensive purposes.”‡ A similar observation is made on the larva of *C. elpenor*. “In this position its appearance is very striking, and gives a formidable look to the creature in the eyes of those animals that might have been thinking to prey upon it.”§ Poulton has proposed that these caterpillars “terrify their enemies by the suggestion of a Cobra-like serpent”;|| an hypothesis not so improbable as would appear if *C. elpenor* is considered a purely European species, whereas it is distributed over “Europe, Japan, Sind, Himalayas, Shillong, Nagas, Manipur”;¶ and thus is found in the area inhabited by the Cobra. Dr. Gregory, in East Central Africa, relates having been “startled by a hissing noise like that of a Snake coming from a clump of grass.” On closer inspection he “could just detect a small green head among the stalks, and behind this appeared, whenever the noise was repeated, an expansion like

* Cf. Lubbock, ‘Ants, Bees, and Wasps,’ pp. 402-3.

† ‘Records Australian Museum,’ vol. ii. p. 91.

‡ W. J. Lucas, ‘Book of British Hawk-Moths,’ p. 109.

§ *Ibid.* p. 113.

|| ‘The Colours of Animals,’ p. 259.

¶ Hampson, ‘Fauna Brit. India,’ Moths, vol. i. p. 85.

the hood of a Cobra." He subsequently found that he "had been frightened by a big Grasshopper, which, by puffing out its wings, assumed a resemblance to the shape of the head of a Hooded Snake; while its noise was a good imitation of the dull jerky hiss of some species of Snakes."*

But it must be remembered, as Mr. Kirby has truly remarked, that though these brightly-coloured caterpillars are probably rejected by insectivorous animals as inedible, they are not protected "against the attacks of parasites, but rather the reverse." He once bred some *Tachinidæ* (parasitic Diptera) from the larvæ of the Spurge Hawk-Moth.† Mr. Pickard Cambridge states that "upwards of a thousand parasitic grubs of the genus *Microgaster* have been taken from a single caterpillar."‡ The many enemies of caterpillars have been described by an Indian observer, who writes:—"Upon the whole I think birds are the least important of a caterpillar's enemies. At first, when it is so minute that a bird would not be at the trouble to pick it up, it is exposed to the cruelty and rapacity of hordes of Ants of many tribes, which scour every tree and shrub, sipping the nectar in the flowers, licking the glands at the bases of the leaves, milking the aphides, and looting and ravaging wherever they go. Besides Ants, every tree swarms with Spiders—not web-Spiders, but wolf-Spiders—which run about in quest of their prey. Then come Wasps and Ichneumons, and these, from a caterpillar point of view, are of two sorts—those which will carry him to their own quarters for the food of their children, and those which will quarter their children on him, or, I should say, *in* him. Finally, the few that have survived all these dangers have to run the gauntlet of the birds."§

Poulton refers to the two Hawk-Moths (*Sesia fuciformis* and *S. bombylifomis*), "which in some degree suggest the appearance of Humble-Bees," as instances of "mimicry of Hymenoptera by Lepidoptera." But when he offered a living specimen to a Lizard (*Lacerta muralis*), the animal was "not imposed upon in the least, but devoured the insect without hesitation or caution. Although Humble-Bees are eaten by Lizards, they are always

* 'The Great Rift Valley,' p. 273.

† "Hanb. Order Lepidoptera," 'Allen's Natr. Libr.' vol. i. p. xxx. note.

‡ 'Royal Nat. Hist.' vol. vi. p. 26.

§ Eha, 'A Naturalist on the Prowl,' pp. 122-3.

seized cautiously, and disabled before being swallowed.”* This certainly seems to be very negative evidence. The well-known British Moth, *Lasiocampa quercifolia*, affects a resting position which “makes it appear exactly like a dead leaf. One is walking along, maybe, when his attention is attracted to a dead brown leaf hanging on a blackthorn bush, suspended by a slender stalk, and swaying to and fro in the air with every passing breeze. You feel satisfied it can be nothing but a rich purplish-brown leaf, and yet your trained eye is hardly satisfied; and as you slowly take in the outline, and put your finger beneath the supposed stalk of the leaf, another slender stalk is gradually pushed up, and a Lappet Moth dangles from your finger.”† Here the expression “trained eye” of the entomologist would suggest a more developed “trained eye” of the moth’s natural enemies, and hence any theory of *protective* mimicry is much discounted. Should such a theory be advanced, the instance would probably be more applicable to conscious or active mimicry, to be discussed later on. The same author gives a subsequent illustration which seems capable of the same comment. Another of our moths (*Orgyia antiqua*) has an apterous female, and in this condition, “seated on her cocoon after emergence, she looks so exactly like a Spider that only *practical entomologists* recognize her; she lays her eggs on the web, and never stirs.”‡ Dr. Sharp has remarked on the eggs of *Phasmidæ* that nearly everyone who mentions them speaks of their extreme resemblance to seeds. “Goldie has suggested that this is for the purpose of deceiving Ichneumons; it is, however, on record that the eggs are actually destroyed by Ichneumons.” Not only do the eggs have a history like that of seeds, and resemble them in appearance, but their capsule, in minute structure, greatly resembles vegetable tissue.§ Again he states:—“The egg of a Phasmid has not only a general resemblance in size, shape, colour, and external texture to a seed, but the anatomical characters of certain seeds are reproduced on

* ‘The Colours of Animals,’ p. 246.

† J. W. Tutt, ‘British Moths,’ pp. 61-2.

‡ *Ibid.* p. 91.—The italics are our own. “Practical entomologists,” in the struggle for existence, and in the sense here meant, naturally includes the insect’s enemies, whose sustenance depends upon their practical knowledge.

§ ‘Cambridge Nat. Hist.’ vol. v. p. 265.

the external surface, there being a hilar area, a hilar scar, and a capitulum corresponding to the micropylar caruncle of such seeds as those of the castor-oil plant (*Ricinus communis*).”* The eggs of *Phyllium crurifolium* are a case in point. Henneguy states “that a prominent lozenge on the egg represents the surface by which the achene of an umbelliferous plant is united to the column, and that the micropyles are placed on this lozenge. As regards the egg-capsule, the same writer observes:—“Almost every botanist, on examining for the first time a section of this capsule, would declare that he is looking at a vegetable preparation.”†

In Plant-life the same suggestions occur. The bladderworts (*Utriculariæ*) are carnivorous, and capture small crustaceans, larvæ of gnats, &c., by the aid of small bladders with orifices closed in each case by a valve, which permits objects to penetrate into the cavity of the bladder, but not to issue out of it. “The bladders of *Utriculariæ*, living in still water, look delusively like certain Ostracoda, especially species of the genus *Daphnia*. The bladder itself resembles the shell-covered body in size and form, and the bristles the antennæ and swimmerets of one of these crustaceans.”‡ Small crustaceans are probably thus allured to their own destruction, and the bladderworts exhibit “aggressive mimicry.” In the ‘Botanical Gazette’ for April, 1896, an interesting case ascribed to mimicry is described. The seeds of the “Philippine Island bean, from the coast near Manila, so closely resemble the quartz pebbles among which they fall, in shape, size, colour, lustre, hardness, and stratification, as to be indistinguishable from them except by a very close examination.”§

Sometimes we read accounts of assimilative colouration, where it is difficult to see the *raison d'être*, if mimicry is propounded. Such an instance is given by Mr. Nicholas Pike:—“On my first visit to Round Island” (near Mauritius), “I captured a Scorpion of a bright green, just the colour of the leaves of the *Jubæa* palm it was disporting on. The creature was very active and defiant, and it was with difficulty I caught him.”||

* In ‘Zool. Results of Arthur Willey Exped.’ pt. i. p. 78.

† ‘Cambridge Nat. Hist.’ vol. v. p. 271.

‡ Kerner and Oliver, ‘Nat. Hist. Plants,’ vol. i. p. 122.

§ ‘Nature,’ vol. liv. p. 106.

|| ‘Sub-Tropical Rambles,’ p. 162.

As proving the great caution which is necessary before dogmatically asserting anything more than "suggested or probable mimicry" with reference to the preceding instances of simulative resemblances in animals and plants, it may be well to record some cases of what may be considered as

Suggestive but Disputed or Mistaken Mimicry.

Prof. Semper, when staying in the Balearic Islands, found among the polypes of a coral (*Cladocora cæspitosa*) Annelids belonging to the genus *Myxicola*, which lived in long mucilaginous tubes which they had formed in the rifts of the coral. "As long as no light was thrown upon them they protruded themselves just so far as that the top rim of the corona of tentacles was on a level with the tentacles of the polyps, so that the worm and the polyps were both extended; the coral itself presented a perfectly level surface of cups. Moreover, the funnels of *Myxicola* were of precisely the same chocolate-brown colour as the polyps; and, when fully extended, the interior of the funnel formed by the tentacles looked exactly like the oval disc of one of the neighbouring polyps, for the radial pinnules were in the same position as those lines which, on the oval disc of the polyp, radiate towards the narrow central oval slit; in the *Myxicola* a small central slit was observable, and all the parts which corresponded so exactly in size and position also displayed exactly the same colouring of greenish grey, with radial lines of a lighter hue and a narrow white streak in the middle. In short, the resemblance in size, position, and colour of every part of the two creatures was so perfect that for a long time I took the corona of the Annelid for a polyp, until, by an accidental blow, I caused all the *Myxicolæ* of a large coral-stock to shrink suddenly into their tubes, though it was not severe enough to induce an equally rapid movement in the polyps of the apathetic *Cladocora*." At the time the Professor "felt an almost childish delight at having detected so flagrant an instance of protective mimicry," but soon found reason to doubt this interpretation of the facts. He subsequently found a marine Sponge in which hundreds of this same *Myxicola* were living, but the Sponge was coloured very differently from the Annelida, so that no protection was offered. Seeking it in other spots, he found the *Myxicola* almost everywhere, "on the rifts of rocks

and in the sand, between marine plants, or the tubes of other worms"; and, whenever he examined it closely, "it was exactly of the size and colour of the polyps of *Cladocora cespitosa*." As Prof. Semper concludes, "Mimicry, it is plain, is out of the question; the resemblance between the two creatures is simply and wholly accidental."* The second illustration is from the pen of Mr. Trimen, so well known for his entomological advocacy of the claims of mimicry, and who describes a most remarkable instance which came to his notice in connection with the pupa of *Papilio lyæus*. He received from a correspondent a small box containing what he took at the first glance for three ordinary green chrysalids of that butterfly. Only one of these objects, however, was a veritable chrysalis, the two others being the seed-capsules of a plant stated to be a species of *Hakea*. "The tint of green, the general lateral outline (especially the bulging ventral convexity of the wing-covers), the projections of the bifid head, the attenuated form of the posterior abdomen and anal extremity, and even the slight ferruginous tips of the projections of the head, are all reproduced in the seed-capsules to a very deceptive extent." The chrysalis was found "in the neighbourhood of a hedge of the *Hakea*, and if this plant had been a native of South Africa it can scarcely be questioned that a strong case of mimicry would readily have been admitted by observers. As a recent introduction from Australia, however, it is clear that *Hakea* cannot have been the model for the pupa of a *Papilio* of a specially African group."† Mr. Belt, so well known for his excellent observations in support of mimicry, gives us another warning against guessing conclusions. "Ant-like Spiders have been noticed throughout Tropical America, and also in Africa. The use that the deceptive resemblance is to them has been explained to be the facility it affords them for approaching Ants, on which they prey. I am convinced that this explanation is incorrect so far as the Central American species are concerned. Ants, and especially the stinging species, are, so far as my experience goes, not preyed upon by any other insects. No disguise need be adopted to approach them, as they are so bold that they are more likely to attack the Spider than a Spider them. Neither have

* 'Animal Life,' pp. 402-3.

† 'South African Butterflies,' vol. iii. p. 241, note.

they wings to escape by flying, and generally go in large bodies easily found and approached." Mr. Belt, however, concludes that the Spider is thus protected against the attacks of small insectivorous birds.* Subsequently, however, Mr. Herbert H. Smith has reaffirmed what Mr. Belt denied—"the Spiders eat the Ants," and "they eat the particular Ants which they mimic. At all events, we verify this fact in a great number of cases, and we never find the Spiders eating any but the mimicked species."† Dr. Scharff thinks "that the colours of Slugs in Ireland are at all ages, as a rule, protective";‡ while Mr. Adams is inclined to think "that climate may be a factor in the matter." He has "taken more brilliant forms, and those more abundantly in the South of England (*where the climate is warmer*), than in the North." Again, "all along the south coasts of England and Wales, Cardigan Bay, and the west coast of the Isle of Man, and the north coast of Ireland (*all of which are noted for a mild climate*), I have taken coloured forms abundantly; while on the coasts of Lancashire and North Wales, and the east coast of England from the Thames to the Tees (*where the climate is more bracing*), I have no personal records for anything but the type."§

In plant-life such resemblances are not uncommon. In parasitic fungi "the fructification of *Polyporus betulinus* strongly resembles the whitish bark of the birch, and that of *P. fomentarius*, parasitic on old beech trees, exhibits the same pale grey as does the trunk of a beech."|| There is a butterfly common in certain parts of the Argentine which Dr. Seitz at first mistook for the European *Vanessa (Araschnia) levana*, so closely does it resemble that butterfly in colour, in the notching of the wings,

* 'The Naturalist in Nicaragua,' pp. 314-5.

† 'Brazil, the Amazons, and the Coast,' p. 223.

‡ 'Slugs of Ireland,' p. 554.

§ 'Coll. Man. Brit. Land and Freshwater Shells,' 2nd edit. p. 23.

|| Kerner and Oliver, 'Nat. Hist Plants,' vol. i. p. 166.

The genus *Volucella* comprise large flies which mimic Humble-Bees in colour and form. As observed by Mr. Pocock: "It was long supposed that the females were thus enabled with impunity to enter the nests of Humble-Bees, and lay their eggs amongst those of the proper owners." But these mimics of Humble-Bees also "visit for the same purpose the nests of Wasps, to which the flies bear no particular resemblance."

and in other ways. Moreover, there is a variety of this form which is in the same way exceedingly like the form *prorsa*. A closer examination of the insect showed that it did not belong to this species at all, or even to the same genus; it is a member of another genus, *Phyciodes*. "If," says Dr. Seitz, "these were found in our country, no one would doubt that this was a case of mimicry as perfect as any which exists." It might be suggested that it is a case of mimicry, but the mimicking and mimicked forms have each gone their own way, one migrating to one country, and one to another; they might possibly at one time have both lived in North America, and later on separated, one going south and the other east, crossing over into Asia by way of Behring's Strait. Such an explanation would be, as Dr. Seitz points out, entirely contrary to what is known of the distribution of these insects; for the genus *Araschnia* is absolutely confined to the Old World, and *Phyciodes* to the New World.* Of course it may be contended that the case does not apply, as it is an integral axiom in the theory of mimicry that the mimicker and the mimicked must, and are, always found together in the same part of the world, or that one of them may have become extinct. But here we see the phenomenon can be observed in widely separated habitats, and in birds one cannot help being amazed at the great superficial resemblance between the Secretary Vulture (*Serpentarius secretarius*) of South Africa, and the Brazilian Seriema (*Cariama cristata*).

Mr. J. H. Gurney has given twenty cases, "On the tendency in Birds to resemble other Species":—"On three occasions adult males of our British Sparrow-Hawk (*Accipiter nisus*) have been shot in this country, which so far resembled the South African (*A. rufiventris*, Smith) as to have the breast and under parts a clear rufous without any transverse bands (cf. 'Ibis,' 1893, p. 346). Buzzards which were indistinguishable from the rufous North African Buzzard (*Buteo desertorum*) have been killed in England three or four times (cf. 'Ibis,' 1889, p. 574). . . . In 1861 an example of *Picus major*, our Greater Spotted Woodpecker, obtained in Shetland, varied so as a little to resemble *P. leuconotus*, the White-backed Woodpecker, and was even figured as such in Gould's 'Birds of Great Britain.' . . . Snipes

* Cf. Beddard, 'Animal Coloration,' 2nd edit. p. 47.

have twice been shot which presented some of the characters of the American *Gallinago wilsoni*.”*

In Southern Africa the Anhinga (*Plotus levaillanti*, Licht.) affords a mimicry which is apparently purposeless. Le Vaillant himself, its discoverer, states:—“Indeed, there is no person who, upon seeing the head and neck only of an Anhinga, while the rest of the body is hid among the foliage of the tree on which it is perched, would not take it for one of those serpents accustomed to climb and reside in trees, and the mistake is so much the easier, as all its tortuous motions singularly favour the illusion.”† This bird swims so low in the water that only its neck is to be seen; and, from observations in Natal, Mr. Ayres says that “in this position the bird might easily be taken, by those unacquainted with it, for a Water-snake.”‡

According to Dr. Bowdler Sharpe, one of the most interesting of all birds is the Common Cuckoo (*Cuculus canorus*), not the least remarkable feature in its conformation being its great similarity to a Hawk, as not only shown by its colour and form, but also by its mode of flight, and which is so marked that the bird is always mobbed by smaller birds, as if it was really a Hawk.§ Jefferies, who excelled as an observer, was clearly not of this opinion, and he thus writes on the subject:—“The Cuckoo flies so much like the Hawk, and so resembles it, as at the first glance to be barely distinguishable; but on watching more closely it will be seen that the Cuckoo flies straight and level, with a gentle fluttering of the wings, which never seem to come forward; so that in outline he resembles a crescent, the convex side in front. His tail appears longer in proportion, and more pointed; his flight is like that of a very large Swallow flying straight.”|| Again he remarks that birds “will pursue a Cuckoo exactly as they will a Hawk,” but adds:—“I will not say that

* ‘Trans. Norf. and Norw. Nat. Soc.’ vol. vi. pp. 241-243.

† ‘New Trav. Int. Parts Africa,’ Engl. transl. vol. i. pp. 181-2.

‡ Cf. Layard’s ‘Birds of S. Africa,’ Sharpe’s edit. p. 783.

§ ‘Royal Nat. Hist.’ vol. iv. p. 3.—It was a saying of Goethe that “there was a time when the study of natural history was so much behindhand that the opinion was universally spread that the Cuckoo was a Cuckoo only in summer, but in winter a bird of prey.” (‘Conversations of Goethe,’ Engl. transl. new edit. p. 295.)

|| ‘Wild Life in a Southern County,’ p. 252.

that is because they mistake it for a Hawk, for the longer I observe the more I am convinced that birds and animals often act from causes quite distinct from those which at first sight appears sufficient to account for their motions."* The dread experienced by small birds for their larger brethren of prey is probably open to qualification, for Gilbert White tells us of a Swallow who "built its nest on the wings and body of an Owl that happened by accident to hang dead and dry from the rafters of a barn."†

As with "mimicry," so the theory of "warning colours" may be hastily predicated. Among Flatworms in the terricolous Triclad or Land Planarians, some species "are frequently banded or striped with brilliant colours. *Geoplana cærulea*, Mos., has a blue ventral surface, and is olive-green or dark Prussian blue above. *G. splendens*, Dendy, is marked dorsally by three stripes of emerald-green alternating with four dark brown longitudinal bands. The mode of colouration, though somewhat variable, is an important specific character. Its significance, however, is not clearly understood. The colours may be a warning signal, as some *Geoplana* at least are disagreeable to the taste of man and some birds; but since Land Planarians are largely nocturnal animals, living by day under logs, banana-leaves, and in other moist and dark situations, this explanation is clearly insufficient."‡ Among the Polychaete Worms the same caution is necessary. "Carnivorous forms like Amphinomids and Syllids present as wide a range of tint as the limnivoruous forms, like *Cirratulus*, *Sabella*, or Maldanids. Shore-lovers and deep-sea dwellers and surface-swimmers all exhibit equally bright or equally sombre tints; it is therefore difficult and rash to dogmatise on the 'use' of these colourings to these animals, or to point to this worm as being protectively, to the other as being warningly, coloured; for we are too ignorant as to the habits of the worms."§

As we record instances of what appear only capable of being ascribed to "suggestive but mistaken mimicry," we meet with natural resemblances which seem to fall under a category of

* 'Wild Life in a Southern County,' p. 265.

† 'Nat. Hist. Selborne' (Harting's edit.), p. 194.

‡ F. W. Gamble, 'Cambridge Nat. Hist.' vol. ii. p. 33.

§ W. Blaxland Benham, *ibid.* p. 293.

Purposeless Mimicry.

Some orchids have a curious resemblance to insects, after which they have accordingly been named the Bee-orchis, Fly-orchis, Butterfly-orchis, &c., but it has not yet been satisfactorily shown what advantage the resemblance is to the plant.* The fungi, known by the name of club-tops, much-branched, flesh-coloured, yellow or white *Clavariæ*, which often adorn whole tracts of ground in a wood, imitate the structure of corals; *Hydneæ* are like Sea-urchins, and *Geaster* like a Starfish, whilst the various species of *Tremella*, *Exidia*, and *Guepinia*, which are flesh-pink, orange, or brownish in colour, and the white translucent *Tremellodon gelatinosum*, resemble gelatinous Sponges. The small stiff Toadstools (*Marasmius*) which raise their slender stalks on fallen pine-needles, remind one of the rigid *Acetabulariæ*. Other Toadstools, with flat or convex caps exhibiting concentric bands and stripes, such as the different species of *Craterellus*, have an appearance similar to the salt-water alga known by the name of *Padina*. Dark species of *Geoglossum* imitate the brown *Fucoideæ*; and one may fancy the red warts of *Lycogala epidendron*, a plasmod fungus inhabiting the rotten wood of dead weather-beaten trees, to be red Sea-anemones with their tentacles drawn in, clinging to grey rocks. However far-

* Sir John Lubbock. 'The Beauties of Nature,' p. 156.—On this point it may be mentioned that Father Kircher, in his *Mundus Subterraneus*, published in Amsterdam in 1678, "depicted the genesis of birds, apes, and men by means of the transformation of some orchids. He had been struck with the resemblance of these strange flowers to many animals, and therefore concluded that the latter were derived from the former." (Cf. Varigny, 'Experimental Evolution,' p. 14.)—*Per contra*, examples abound of men, who, undoubtedly authorities on their own subject, needlessly give themselves away by ludicrous comments on matters of which they are absolutely ignorant. An amusing instance of this may be found in W. Day's well-known book 'The Racehorse in Training.' The author of this book, thoroughly versed in his own business, having passed through the stages of an accomplished jockey, a successful trainer, and an astute owner, in discussing the evils of "sweating" horses, which he ascribes to "theory," points the moral of his tale by alluding to other theories, not excluding that of Mr. Darwin. We are treated to the following effusion:—"We have Mr. Darwin's theory, arising out of Lord Monboddo's idea. His lordship said over a century ago, 'that in some countries the human species have tails like other beasts, and traces Monkeys up to men.'" ('The Racehorse in Training,' 5th edit. p. 90.)

fetched this comparison between the two localities may seem at first sight, everyone who has had an opportunity of thoroughly observing the characteristic forms of vegetable and animal life in woods, and at the bottom of the sea, will inevitably be convinced of its accuracy.* Again, in primitive plant life (Thallophyta), in the family *Caulerpaceæ*, "the genus *Caulerpa* contains nearly one hundred species, which present the most varied external forms, simulating those of many of the higher plants, such as Mosses, Ferns, Mare's-tails, Cactuses, Conifers, &c."† It has been suggested that some of the seeds of *Euphorbiaceæ*, notably those of the Castor-oil plant (*Ricinus*), resemble beetles, and, as such, may be mistaken by birds and carried a small distance before being dropped. This seems very doubtful. *Ricinus* seeds and those of Para Rubber (*Hevea brasiliensis*), which resemble them on a large scale, are ejected explosively from their capsules to a distance quite sufficient for their dispersal, and falling, as they constantly do, among the herbage, would certainly escape most insect-eating birds.‡

Fishes of the family *Pomacentridæ*, belonging to the spiny-finned division, which frequent the neighbourhood of coral reefs and islands, and thus closely resemble the scaly-finned fishes, Chætodonts, in their mode of life, also are very similarly and beautifully coloured. But in the opinion of Dr. Günther this is one of many instances showing that the colouration is due to a great extent to "the agencies of climate, of the surroundings, and of the habits of animals."§

Active Mimicry.

Another and very important distinction to be drawn when dealing with instances of mimicry and protective resemblance is one long since pointed out by Kirby and Spence, and one that demands the utmost consideration. To use the words of the teleological authors of the immortal 'Introduction to Entomology,' there are *Passive* means of defence, such as are independent of any efforts of the insect; and *Active* means of defence, such as

* Kerner and Oliver, 'Nat. Hist. Plants,' vol. i. p. 112.

† *Ibid.* vol. ii. p. 645.

‡ H. M. Ridley, 'Nat. Science,' vol. viii. p. 196.

§ 'Introduct. Study Fishes,' p. 524.

result from certain efforts of the insect, in the employment of those instincts and instruments with which Providence has furnished it for this purpose.* Thus, in a little book on British Hawk Moths, the writer states that some of these insects "seem to put all their trust in a resemblance they may bear to some natural object, which by a wonderful and unerring instinct they seldom fail to find."† Many of the illustrations given by authors of protective resemblances and mimicry are "passive," and considered as the result of natural selection, slowly accentuating and perpetuating the current of variation that makes for protection, and of which, on every philosophical consideration, the animal thus evolved can have no consciousness, beyond a more or less habit of adaptation to its environment; in fact, a Cartesian would say the whole phenomenon was indicative of animal automatism. But it is open to strong suggestion that this is only one, and a subordinate phase of the phenomenon, and that animals of their own volition, and in their efforts to avoid their enemies, place themselves where possible in such adaptation to their surroundings, that protective resemblance and some forms of mimicry are due to animal intelligence, and not so entirely to what is generally understood as the unconscious process of natural selection.‡ Mr. Coe has also affirmed that "there is an enormous amount of evidence, which shows that animals are conscious of the protection afforded by colour, and that they assist the 'disguises' which arise from their likeness to inanimate objects by their own intelligence and contrivance."§ Thus Mr. Wakefield Richardson has recently recorded an observation he made by which a Wren

* 'Introd. Entomology,' 2nd edit. p. 404.—Prof. Henslow has also quite recently remarked "that there appears to be two distinct kinds of mimicry: (1) automatic and unconscious; (2) brought about by conscious action of the creature." ('Journ. Roy. Horticultural Soc.' xxiii. p. 28 (1899).)

† W. J. Lucas, 'Book of Brit. Hawk Moths,' p. 13.

‡ Col. Pollok has suggested an excellent example of limited intelligence in the Tiger:—"All Deer possess an acute sense of smell, and against it a Tiger has to contend before he can provide his larder with game; but how does he manage it? We cannot give him the credit of the intellect of man, who, in pursuit of game, is well aware nothing can be done down wind. Were it so, not a Sambur or Deer would be left alive. The Tiger would bag them all just as he pleased,—in fact, he would then be able to kill any Deer when he wanted it." ('Zoologist,' 1898, p. 155.)

§ 'Nature *versus* Natural Selection,' p. 171.

supplied the insect food required for her young by carrying the excrements of the nestlings, as is the habit of some birds, and placing them with great care on different parts of a thorn bush. "Apparently she had placed them thus to attract the flies, for each time she alighted on the bush she visited several, picking off the flies until she had enough to take back to her young."* This may surely be taken as an instance of aggressive mimicry, consciously or actively pursued. According to Mr. Matthias Dunn, "Some fishes have such power over their own appearance that when they like they can change the colour of their skin in keeping with their surroundings. I have seen Surmullets, when going from the brown sand to the dark rocks, quickly change from one colour to the other, and I know of about forty other fishes which can do the like in more or less time."† On this statement a writer has recorded that, in 1898 in the Aquarium at Concarneau, in Brittany, Turbot were seen "that gradually assumed the colour of the sand in which they were placed; so much so that it required a very keen eye to detect them lying at the bottom of the tank."‡ Another writer has more recently remarked, in discussing "the beautiful and protective resemblance" which some insects "bear to their surroundings," that there can be no doubt that such species "possess an inherited and instinctive knowledge of this assimilation, and select such places as a protection against their *natural* enemies."§ Of course the suggestion of active mimicry must not be made too absolute. Thus Mr. Storrs Fox has proposed a very reasonable hypo-

* 'Field,' July 29th, 1899, p. 227. Cf. also Dr. John Lowe, 'Zoologist,' 1896, pp. 1-10, as to habits of both Blackcap and Garden Warbler at Teneriffe.

† 'Contemporary Review,' vol. lxxvi. pp. 202-3. This observation has a distinct reference to what we previously discussed as "Assimilative Colouration," which cannot be divorced from the consideration of the theory of "Mimicry."

‡ J. G. in 'Westminster Gazette,' Aug. 10th, 1899.—A blind fish, according to the observation of Pouchet, is unable to respond to the colour of its surroundings." (Cf. Blake, 'Journ. Roy. Horticultural Soc.' xxiii. p. 24, 1899.) Prof. Henslow has given an analogous case in which the eyes of Shrimps had been covered, and the result was that "these Shrimps were not coloured like the normal ones, in imitation of their surroundings." (*Ibid.* p. 28.)

§ T. B. Jefferys, 'Entomologist,' vol. xxxi. p. 241.

thesis that supposing certain caterpillars not very particular as to their food, either Elm, Lime, Birch, &c., and further assuming that such caterpillars were more easily overlooked on Birch by resembling the catkins of that tree, then those broods which fed on trees other than Birch would be most likely to be devoured by enemies, and so gradually a race would grow up which invariably fed on Birch.*

The active mimicry here discussed does not deal with the mimicking by birds of the songs of their fellows. This imitative faculty had been recorded of birds in captivity by Aristotle. But in a state of nature the same thing occurs. Mr. Butterfield has narrated his having heard a Whinchat, a bird of no extensive vocal capacity, imitate "in quick succession the song of the Wren, Song Thrush, Chaffinch, Corn Bunting, Tree Pipit, Greenfinch, and Starling."† Mr. Riley Fortune has known the Starling to give perfect imitation of the cries of the Sparrow, Lapwing, Golden Plover, Chaffinch, Blackbird, Yellowhammer, Thrush, Jackdaw, Swallow, and many other birds.‡ Prof. Lloyd Morgan is of opinion that "mimetic activities are due to a mimetic impulse. Some of them are probably involuntary and due to connate impulse; but others are certainly due to intelligent imitation."§ Thus Lumholtz, in Queensland, observed the mental process in the Lotus-bird (*Parra gallinacea*): "The grown bird is not shy, but the young are extremely timid. I had once or twice seen the old birds with young, but as soon as I approached them the young always disappeared, while the old birds walked about fearlessly, as if there was no danger. It long remained a mystery to me how they could conceal themselves so well and so long, but one day the problem was solved. An old bird came walking with two young ones near shore. I hid behind a tree and let them come close to me. As I suddenly made my appearance, the small ones dived under the water and held themselves fast to the bottom, while I watched them for a quarter of an hour before

* Extr. MS. Lecture to the Bakewell U. E. Students' Association.

† 'Zoologist,' 1877, p. 384.—Mr. Godfrey in these pages (*ante*, p. 267) has also corroborated this bird's power of mimicry.

‡ 'Ornithology in relation to Agriculture and Horticulture' (1893), p. 142.

§ 'Natural Science,' vol. vi. p. 328.

taking them up."* The difficulty in cognizing the phenomenon of active mimicry is no greater than that experienced in endeavouring to explain the derivation, or evolution, of active means of defence, in fact it is much less formidable; for it is easy to comprehend even from our own experience that concealment is frequently a need, and is an art capable of cultivation and improvement. But many of the means of animal defence are in themselves almost inscrutable; we see the weapon used, but cannot account for its present existence. Natural selection may explain the improvement and survival of such useful organs, but their origin is still obscure. We will briefly allude to a few in order to make our comparison clear. The Horned Lizard (*Phrynosoma* sp.), commonly known as the "Californian Toad," possesses the power of ejecting jets of blood from the eyes, apparently as a means of defence. The Sand Shrimp (*Crangon vulgaris*) can suddenly raise a perfect cloud of fine sand round itself—"firing, so to speak, a 'broadside for the sake of the smoke,' and literally throwing dust in the eyes of his enemies."† The well-known instance of the "Cuttle-fish," which is able to discharge its inky secretion, and escape, like a diplomatist, in the darkness thus effected, is another illustration, as is also the Bombardier Beetle (*Pheropsophus* sp.), which when caught explodes its abdominal artillery, producing sound, smoke, and pain alike. The larva of the Puss Moth (*Cerura vinula*) can squirt a fluid—formic acid—when handled.‡ The common Partridge will "feign itself wounded and run along the ground fluttering and crying before either dog or man, to draw them away from its helpless unfledged young ones."§ Sometimes the indications of intelligent action may be almost inappreciable to our untrained cognitions in animal psychology, but even then the loosely used, and still more vaguely understood term, instinct, would have to be applied. At other times volition seems to be influenced by environment. Humboldt relates that "in the Missions of the Orinoco, and on the banks of the river Amazon, the Indians who

* 'Among Cannibals,' p. 23.

† W. B. Lord, 'Crab, Shrimp, and Lobster Lore,' p. 74.

‡ J. W. Tutt, 'British Moths,' p. 101.

§ Gilbert White and Markwick, 'Nat. Hist. Selborne,' Harting's edition, p. 325.

catch Monkeys to sell them, know very well that they can easily succeed in taming those which inhabit certain islands; while Monkeys of the same species, caught on the neighbouring continent, die of terror or rage when they find themselves in the power of man. The Crocodiles of one lake in the llanos are cowardly, and flee even when in the water; whilst those of another lake will attack with extreme intrepidity. It would be difficult to explain this difference of disposition and habits by the mere aspect of the respective localities. The Sharks of the port of La Guayra seem to furnish an analogous example. They are dangerous and bloodthirsty at the island opposite the coast of Caracas, at the Roques, at Bonayre, and at Curassao; while they forbear to attack persons swimming in the ports of La Guayra and Santa Martha."* According to Hudson, the Puma possesses "a unique instinct of friendliness for man," though it violently attacks other large Carnivora, and is, within the tropics, "a great hunter and eater of Monkeys, which of all animals most resemble men."† Another instance is the "dying-places" of the Guanaco (*Lama guanacus*) at the southern extremity of Patagonia, as recorded by Darwin, Fitzroy, and Hudson. That young Haddock should frequent deep water, and the young Cod seek the inshore water, "is one of those mysteries it is difficult to unravel."‡ The Apron (*Aspro vulgaris*), a freshwater fish belonging to the family *Percidæ*, according to Prof. Seeley, "lives at the bottom, and comes to the surface only in bad weather with a north or west wind, when other fishes take refuge at the bottom."§

Many actions of animals of a peculiar, constant, and distinctive character seem quite purposeless. This is particularly striking in the account given of the habits of the two species of African Rhinoceros (*R. simus* and *R. bicornis*). The calf of *R. simus* "always runs in front of the cow, while the calf of *R. bicornis* invariably follows its mother; this habit never varies." Again, *R. bicornis*, after dropping its dung, "proceeds

* 'Personal Narrative,' Bohn's edit. vol. i. p. 377.

† 'The Naturalist in La Plata,' pp. 48-9.

‡ Cf. McIntosh, 'Fifteenth Annual Report of the Fishery Board of Scotland,' p. 207.

§ 'The Freshwater Fishes of Europe,' p. 48.

to stamp upon the dung and to tear and dig up the ground in the immediate vicinity, so that there is absolutely no chance of anyone missing the place where a *R. bicornis* has spent the day. *R. simus*, however, leaves his dung alone, and does not trample and scatter it about; moreover, he is conservative in these matters; he always drops his dung in one place until he has raised a huge heap, then he starts the same operation in another place, and so on."* In Patagonia, the Guanaco has somewhat similar habits. Cunningham writes:—"Darwin has commented on the singular habit which they possess of depositing their droppings on successive days in the same defined heap, and this I have likewise frequently observed."† According to Romanes, "The dusting over of their excrements by certain freely roaming carnivora; the choice by certain herbivora of particular places on which to void their urine, or in which to die; the howling of Wolves at the moon; purring of Cats, &c., under pleasurable emotions; and sundry other hereditary actions of the same apparently unmeaning kind, all admit of being readily accounted for as useless habits originally acquired in various ways, and afterwards perpetuated by heredity, because not sufficiently deleterious to have been stamped out by natural selection."‡

* Coryndon, 'Proc. Zool. Soc.' 1894, pp. 331-2.—Col. Pollok relates a similar practice of the Indian Rhinoceros (*R. unicornis*):—"Whilst it remains in a locality it will deposit its ordure only on one spot, and visits it for that purpose once when it commences feeding at night, and again before leaving off soon after daybreak." ('Zoologist,' 1898, p. 173.)

† 'Nat. Hist. Straits Magellan,' p. 109.

‡ 'Darwin and after Darwin,' vol. ii. p. 89. For further treatment on this topic, cf. same author's 'Mental Evolution in Animals,' pp. 274-285, 378-9, 381-3.

(To be continued.)

THE MODE IN WHICH BATS SECURE THEIR PREY.

BY CHARLES OLDHAM.

OBSERVATIONS made during the past few months have to a great extent confirmed my suggestion (*ante*, p. 51) that the method adopted by the Whiskered Bat (*Myotis mystacinus*) and the Long-eared Bat (*Plecotus auritus*) to secure their prey was common to other species. This curious habit seems to be little known, or, if noticed at all, to have been misunderstood,* and is so remarkable that a further description of it, even at the expense of repetition, will, I trust, be forgiven.

When walking, most of our British Bats carry the tail curved downward and forward beneath the body, the interfemoral membrane forming a pouch or bag. If a moth or other large insect be encountered, the Bat seizes it with a rapid snatch, slightly spreading its fore limbs with the wings still folded, and, pressing them firmly on the ground at the carpus in order to steady itself, brings its feet forward in order to increase the capacity of the pouch, into which, by bending its neck and thrusting its head beneath its body, it pushes its prey. If the moth be a large one the Bat often struggles convulsively for a few seconds before it can adjust its grip to its satisfaction; but once in the pouch the insect rarely escapes, and, when effectually secured, is brought out and eaten openly. If the Bat can be induced to feed whilst hanging head downwards, suspended by its toes, its actions can be observed much more easily. Its tactics are then more efficacious, as the tail is not pressed close to the belly, and the pouch is in consequence held open, as it would be, of course, during flight.

This habit, practised readily and frequently in captivity, is so perfect an adaptation of means to an end that it must obtain with equal frequency among Bats in a free state. These creatures,

* In Bell's 'British Quadrupeds,' 2nd edit. p. 64, Daubenton's Bat is described as thrusting its nose more or less downwards under its breast in feeding; and in 'The Zoologist,' 1890, p. 99, a captive *Pipistrelle* is said to have beaten moths against its breast to stun them.

when at large, capture most, if not all, of their food during flight—I have known a captive Long-eared Bat to remain on the wing for over an hour at one time—and it seems in the highest degree probable that they habitually use this method to secure insects which are large and vigorous, and therefore difficult to manage, without being compelled to alight.

One species at any rate has actually been observed to use the interfemoral membrane as a pouch when on the wing. My friend Mr. J. R. B. Masefield writes, under date March 1st, 1899:—"I have no doubt whatever that the Long-eared Bat makes use of the interfemoral pouch in the way you mention. I have been close to them when picking moths off shallows, and the Bat always hovers when taking off the moth, and bends up the tail so as to form a receptacle for the insect as it drops. As you know, the sallow-feeding *Noctuæ* (*Tæniocampa gothica*, *stabilis*, *instabilis*, *cruda*, &c.) all drop immediately the flower or bush is touched or shaken, and thus the head of the Bat and the interfemoral pouch form a trap from which the moth cannot escape. When feeding in captivity I have often seen this Bat, as soon as it had seized a moth, sit, as it were, on its tail and double up its head in the way you describe. The Long-eared Bat does not always succeed in holding a large moth at the first snap, and this is an additional argument in favour of your theory." A Long-eared Bat which I found in the old copper-mines on Alderley Edge, and kept for some days in February last, used always to thrust moths (*Scotosia dubitata* and *Gonoptera libatrix*) into its pouch, but only treated mealworms in this manner when they struggled violently, seizing and eating them at other times quite openly.

In July and August I caught several examples of Daubenton's Bat (*Myotis daubentoni*) as they emerged from a hole beneath the eaves of a house near Redes Mere, Cheshire. They seized and ate mealworms quite openly, but always thrust moths into the interfemoral pouch. Small thin-bodied moths (*Cidaria populata*) were thrust in and withdrawn again almost immediately; a larger species (*Urapteryx sambucata*) was obviously more difficult to manage, whilst vigorous thick-bodied species (*Xylophasia polyodon*, *Triphæna pronuba*, and *Mamestra brassicæ*) occasioned many struggles, and were not firmly secured until they had been held in the pouch for some seconds. Once, one of the Bats, having seized a

large and powerful *T. pronuba*, brought its feet so far forward that it fell over on to its back, but pluckily held the moth in its pouch until it was secured. Owing to the late hour at which it appears in the evening, it is not easy to distinguish the actions of this Bat as it skims over the shady pools which are its favourite haunts. It probably subsists to a large extent on gnats and other insects which fly just above the surface of the water and are too small to necessitate the use of the interfemoral pouch. Its behaviour in captivity shows, however, that, when occasion requires, this method of securing its prey is readily and effectually adopted. Daubenton's Bat has the tail only slightly curved during flight, to about the same extent as the Pipistrelle, less than the Whiskered and Long-eared Bats, and more than the Noctule, which holds its tail almost straight behind it. In his account of Daubenton's Bat, Tomes says (Bell, 'British Quadrupeds,' 2nd edit. p. 64):—"When a fly or other food was taken which was rather large, the carpus was always brought into use to do the office of a hand, and the food was pushed into the mouth with it." This is entirely opposed to my experience, for neither this Bat nor any of the other species I have kept has ever made use of either carpus or foot in feeding.

The Pipistrelle (*Pipistrellus pipistrellus*) is abundant in the neighbourhood of Alderley Edge, and I have kept several for a few days at different times during the past summer. The habit under consideration is much less pronounced in this species than in those already mentioned. My captives used to seize and eat mealworms quite openly, but on one occasion a particularly large and vigorous worm was thrust into the pouch. Thin-bodied moths (*Larentia fluctuata* and *Cidaria populata*) were also seized and eaten openly, as was a male *Hepialus sylvinus*; but larger moths (*T. pronuba*, *Polia chi*, and other *Noctuæ*) were pouched before being eaten.

The Noctule (*Pipistrellus noctula*) occurs commonly at Alderley Edge, but my efforts to obtain one alive have so far been unsuccessful. This Bat comes abroad early, and during the long midsummer evenings is silhouetted so clearly against the sky that the contour of its ears may be seen distinctly. Under such favourable conditions I have spent hours watching Noctules, both with the naked eye and with a strong glass, but have never seen

them use the interfemoral membrane as a pouch, nor have I been able to detect them using the thumb to rend asunder their prey, as Mr. O. Grabham (*ante*, p. 131) states they do. It is certain that the oblique downward plunge, so noticeable in the flight of the Noctule, is not *always* due to the loss of balance which would be involved in bringing the thumb to the mouth, for I have often seen Noctules plunge when the light was sufficiently good to show that both wings were fully extended. Mr. T. A. Coward, who has constantly watched Noctules in Dunham Park, suggests that a loss of balance would involve a vertical fall such as occurs when one wing is broken by shot, and not an oblique dive with extended wings. It must be remembered, however, that the diet of the Noctule is not restricted to large beetles (*Melolontha* and *Geotrupes*), and neither the pouch nor the thumb would be required to secure or dismember small insects; but whether this species uses the interfemoral membrane as a pouch, as its congener the Pipistrelle undoubtedly does, could be definitely settled by observing individuals in captivity.

A number of Lesser Horseshoe Bats (*Rhinolophus hipposiderus*), obtained at Cefn, Denbighshire, on March 4th, died before the end of the third day of their captivity. I could not induce them to feed, and they were so loath to take wing that I was unable to ascertain definitely the position of the tail during flight. In repose this organ is reflexed over the back (*cf.* R. Newstead, Zool. 1897, p. 538), and when on the ground the Bat carries it erect, *i. e.* at right angles to the long axis of its body. The legs showed very distinctly against a white ceiling when viewed from below, but this was possibly due to the shortness of the tail, and not to its being erect or recurved. Even if the tail were curved beneath the body during flight, its shortness and the small extent of the interfemoral membrane would constitute only an inefficient pouch, and it seems improbable that in the genus *Rhinolophus* these parts subserve the same purpose as in *Plecotus*, *Myotis*, and *Pipistrellus*.

I have put together these notes in the hope that others interested in the British Bats, who may be able to obtain the Barbastelle, Natterer's Bat, the Noctule, and more especially the Horseshoe Bats, will make observations on the methods adopted by them to secure their prey.

NOTES AND QUERIES.

MAMMALIA.

CHIROPTERA.

Death of a Whiskered Bat by Misadventure.—In spite of the adroitness with which Bats avoid obstacles encountered in their rapid flight, and the precision with which they thread their way among the branches and foliage of trees, they are not exempt from occasional accidents. At the end of last April, when walking along the margin of the mere at Siddington, I saw a Whiskered Bat (*Myotis mystacinus*), as I thought, asleep and hanging by its feet to a brier overhanging the water. A closer examination showed that the wings were half open, and not folded closely to its sides as in sleep, and that the Bat was not supported by its feet, but by a thorn which had pierced the interfemoral membrane on the right side close to the extremity of the tail. In its struggles to free itself, the Bat had lapped its tail firmly round the twig from which the thorn projected, and was thus held a fast prisoner. When found it was alive but moribund, and a large portion of the wing-membrane was already dry and shrivelled. It made a feeble but unsuccessful attempt to drink some milk which I offered it, but died within two hours of its release.—CHAS. OLDHAM (Alderley Edge).

AVES.

Is the Whinchat a Mimic?—In confirmation of Mr. Robert Godfrey's affirmative answer to this question respecting *Fratincola rubetra* in 'The Zoologist' (*ante*, p. 267), I venture to quote the following from St. John's 'Natural History and Sport in Moray' (p. 147):—"May 28th (1850). The loch (Spynie) is full of Sedge Warblers now. I heard a most extraordinary singing in some alders to-day; at one time it was like a person whistling, at another like a very sweet and full-toned Blackbird, but always ending in a song like a Sedge Warbler. After watching it for some time, we shot the bird, which turned out to be a Whinchat. I cannot understand its note, quite unlike any bird that I ever heard."—F. FINN (Indian Museum, Calcutta).

Icterine Warbler and Buff-breasted Sandpiper in Norfolk.—It may interest readers to know that on September 5th I secured an Icterine Warbler (*Hypolais icterina*) in some scrub between Wells and Cromer.

The light margins of the tertiaries were very conspicuous as it flew, giving it somewhat the appearance of an immature Pied Flycatcher. There was nothing in the stomach. It arrived when the wind was south-west. On Sept. 7th I shot an immature Buff-breasted Sandpiper (*Tryngites rufescens*) near the same spot. It appeared a dull sandy colour as it rose, and the flight was slow. It was a fine day, with north-west wind following forty-eight hours of a wet south-easter. It proved to be a male, and there were some green-coated beetles in the stomach. Both birds were afterwards examined by Mr. J. H. Gurney at Norwich. I believe this Sandpiper has not occurred in Norfolk for fifty-six years. Curiously enough, I was not far off when the last Icterine was killed by Mr. R. Gurney in 1896, and I saw his bird in the flesh. We compared the two in Norwich Museum, and they were very similar, but some skins then produced were of a decidedly yellower colour.—E. C. ARNOLD (The Close, Winchester).

Swallows and Hobbies.—Last year, on Sept. 8th, while watching the vast gatherings of Swallows and Martins which at this time assemble to roost in a large withy-bed near here, I observed a small long-winged Hawk darting about among them, but was unable to determine the species owing to the growing darkness. During the last few days, however, I have repeatedly seen one or more Hobbies (*Falco subbuteo*) performing wonderful evolutions among the dense clouds of Swallows at sunset, and looking themselves very much like Swallows magnified two or three times. Last night (Sept. 11th) a Hobby arrived rather too soon, and made off again when he found no Swallows in the usual place. I have not as yet been able to see these beautiful little Falcons secure a victim, nor did the Swallows appear to be much disconcerted by their presence. Except at this time of year, I have never seen a Hobby here, and I suppose it is possible that these birds are following the Swallows on their autumnal migration. I find that in his 'Birds of Wilts,' p. 73, the Rev. A. C. Smith noted a similar occurrence in that county, when several Hobbies waited upon vast flocks of Sand Martins which assembled nightly to roost in withy-beds. — W. WARDE FOWLER (Kingham, Chipping Norton).

Breeding of the Tufted Duck in South-west Derbyshire.—As the records of the breeding of this Duck (*Fuligula cristata*) in Derbyshire are somewhat scanty, and in the new edition of Howard Saunders's 'Manual' it is not mentioned in the list of counties in which this bird is known to breed, the following notes with regard to the Ashbourne district are worth recording:—F. B. Whitlock ('Birds of Derbyshire,' p. 172) mentions, on the authority of Mr. F. B. Wright, that "a pair bred at Osmaston Manor Lake in 1854." No doubt they bred occasionally after that date, but it was not until about 1886 that they began regularly to resort to the ponds for

breeding purposes. Since then a brood or two has been reared almost every year, and during the present summer (1899) at least two broods have been successfully hatched off. From Osmaston they seem to have spread to neighbouring ponds, and at a private sheet of water not far off they were first noticed about 1889, and have now bred regularly for some years past. Two nests were found only a few yards apart on May 28th and June 1st of the present year, with fifteen and nine eggs respectively. Both these nests were taken, but they began to lay again very soon afterwards, and fresh nests were found on June 6th (eight eggs) and June 16th (eleven eggs). Unfortunately both these nests were destroyed, and it is doubtful whether any birds were reared here this year. Attempts have been made to colonize other likely spots in the district, for they were observed on the Ashbourne Hall pond in the spring of 1892, and one couple certainly bred at Sturston Mill in 1895, and probably also in the following year.—FRANCIS C. R. JOURDAIN (Clifton Vicarage, Ashbourne).

Grey Phalarope in Co. Armagh, Ireland.—On Sept. 30th I received, from Mr. W. Keatley, a male Grey Phalarope (*Phalaropus fulicarius*), young of the year, shot by him on Sept. 28th on the Logan, near Lurgan. It was too damaged to set up, but the back, wings, head, and tail are preserved as a flat skin.—H. W. MARSDEN (Clifton, Bristol).

AVICULTURAL NOTES.

The Colour of the Iris in the Jay.—In all books that I have consulted which deal with British Birds, the iris of the adult Jay is said to be pale blue; and Howard Saunders, in his 'Manual of British Birds,' states that the young bird differs in having brown eyes. Towards the end of May, 1898, I had a young Jay given to me; it had been taken from the nest about a fortnight previously (with three others). When it came into my possession its irides were silver-grey, and this colour they retained until the second moult (in August of the present year), when they gradually changed to vinous brown. The bird is an exceptionally handsome and vigorous male, in every respect so well developed that when its crest is depressed the corners form distinctly perceptible ear-like terminations on each side at the back of the head. Is the colouring of the irides abnormal in my specimen, or has the colouring in young and adult birds been inadvertently reversed by describers?—A. G. BUTLER (Beckenham, Kent).

EDITORIAL GLEANINGS.

MR. W. L. SCLATER, the Director of the South African Museum at Cape Town, has prepared, for the use of his friends and correspondents, a 'List of the Birds of South Africa' (Cape Town, 1899). This list comprises the species of birds found within the area over which his proposed 'Fauna of South Africa' will extend. This area is thus defined:—"The northern limits of South Africa, as treated of in this work, will be a line drawn from the Cunéné River on the West to the Zambesi at the Victoria Falls, and thence along that river to its mouth. Within it will therefore be enclosed the British Colonies of the Cape and Natal, the two Republics of the Transvaal and the Orange Free State, the southern half of the Chartered Company's territory, German South-west Africa, and that portion of Portuguese East Africa which lies south of the Zambesi." The number of species enumerated in this list is 775, to which, however, considerable additions will doubtless have to be made. The first volume, by Arthur C. Stark, M.B., containing Part I. of the Birds, will shortly appear, and it is hoped that that relating to the Mammals, by Mr. Sclater, will be ready for publication during the course of the present year. This work will be a worthy companion to 'The Fauna of British India,' edited by W. T. Blanford. The London publisher is Mr. R. H. Porter.

THE Natural History Department of the British Museum have issued a small pamphlet, 'How to collect Mosquitoes' (*Culicidæ*), and doubtless any traveller or resident abroad who is willing to assist the Museum by sending specimens can freely obtain this useful guide for collecting, preserving, and transmitting. It contains much accurate zoological teaching. Mosquitoes or Gnats (strictly speaking the terms are synonymous) are the names popularly applied to the family *Culicidæ* (Diptera). *Culicidæ* are by no means the only blood-sucking Diptera, for the order also comprises the blood-sucking Midges (genus *Ceratopogon*, belonging to the family *Chironomidæ*), the *Simulidæ*, *Tabanidæ*, and blood-sucking *Muscidæ* (*Glossina*, *Stomoxys*, *Hæmatobia*). The females of all of these suck blood in the perfect state, while the males are usually harmless, though in the Tsetse fly the blood-sucking habit is stated to be common to both sexes,* as has

* Surgeon-Major David Bruce, A.M.S., 'Further Report on the Tsetse Fly Disease, or Nagana, in Zululand,' p. 3. London: Harrison & Sons. 1897.

been asserted to be the case in certain species of Mosquitoes. The other blood-sucking Diptera, with the possible exception of *Ceratopogon*, are sufficiently distinct from *Culicidæ* in outward form to obviate any risk of confusion. In countries in which Mosquitoes abound they are recognized without difficulty. In England, however, where some seventeen species of the family occur, though not, as a rule, in any great abundance, or causing much annoyance by their bites, a large amount of confusion apparently exists as to the characteristics of a Mosquito, or, as it is more commonly called, a Gnat. This confusion is mainly due to the fact that the Midges (*Chironomidæ*), which, with the exception of the genus *Ceratopogon*, are perfectly harmless, often attract attention from the habit of the males of dancing in the air in swarms on fine evenings in spring and early summer, and, owing to their similarity in shape, size, and general appearance, are commonly mistaken for Gnats (*Culicidæ*). A good plate well exhibits the differences between the wing of a Mosquito or Gnat (*Culex* sp.) and of a Midge (*Chironomus plumosus*).

WE have received from Messrs. Friedländer and Sohn, of Berlin, a complete set of their 'Naturæ Novitates' for 1898, bound in one volume. This well-known publication, which not only records current biological literature, but is also a priced catalogue by which very many *separata* may be obtained, is much enhanced in value and convenience by being issued in a yearly volume. A good index is appended, and one "made in Germany" is seldom to be despised.

By the death of Samuel Stevens, F.L.S., F.E.S., who died on August 29th, after a few days' illness, in his eighty-third year, many readers of this magazine will regret the loss of a friend, and of a very familiar figure at meetings of naturalists, especially at those of the Entomological Society and Entomological Club. At the first—with one exception—he was the oldest member; of the second he was practically at one time a preserver. As an entomologist, he was a collector and lover of the study rather than a scientific worker, and probably acquired more happiness from the pursuit than is obtained by many of the better known and more technical workers. At one time he conducted a Natural History Agency, and was broker in the sales of the enormous collections made by Bates and Wallace. As to the way he conducted this business, the late H. W. Bates has often spoken to the writer of the gratitude he felt for the exhaustive manner in which his interests were safeguarded by Stevens. As these old familiar faces pass away, we realize how the old order changeth, and how practically we are meeting new men and an almost new science. Many present naturalists will long cherish the remembrance of kindly Samuel Stevens.

IN the 'Scientific American' there has recently appeared a memoir on "The Pearl-Button Industry of the Mississippi River," by Mr. Hugh M. Smith, of the U. S. Commission of Fish and Fisheries. The manufacture of buttons from the shells of native fresh-water Mussels began in the United States in 1891. Button-making has now become one of the principal businesses along a section of the Mississippi nearly two hundred miles in length. There are about four hundred species of Mussels found in the Mississippi River and its tributaries, but comparatively few are now utilized in or are adapted to button-making. We naturally find complaints as to the treatment of the "golden goose." "Not the least injurious feature of the fishery is the gathering of small Mussels for market, and the incidental destruction of small shells that are not utilized, but left on the banks or the ice to die." Mussels have many perils to surmount. "Animals which are known to prey on the Mussels are Muskrats, Minks, Raccoons, and Hogs, the first and last being especially destructive. The freshets to which the Mississippi is periodically subject undoubtedly do great damage to the Mussel-beds, burying them under sand and mud. Shifting sand-bars are also known to cover up beds. The fishermen sometimes find extensive beds of dead shells which appear to have been recently uncovered by the current. During freshets, when the stream finds new channels, many Mussels are carried from their beds, and left dry when the water subsides. Droughts are also liable to expose Mussel-beds, and cause much destruction. However, pollution of the water by refuse from cities and manufacturing establishments is perhaps the most serious menace to the Mussel-beds, next to the operations of the fishermen."

